

The Use of Virtual and Augmented Reality in University Didactics in The Field of Logistics*

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Abstract

The development of information technology, including digitalization, affects the process of educating students. In order to ensure the best possible preparation of students to enter the labor market, it is necessary for educators to follow what is happening in business. There are many technologies available on the market. In this short article, I want to discuss the possibilities of using virtual and augmented reality in the didactic process of logisticians and share my own experiences in this area. The paper presents using VR and AR application in the studies of Logistics – a real cases at University. The author presents at this article examples of benefits of using virtual reality and augmented reality in combination with computer simulation in the logistics field.

Keywords: virtual reality, augmented reality, university didactics, logistics

Introduction and topic idea

The constant development of information technologies forces them to be included in the didactic process. It is impossible to educate good graduates who are ready to work in current conditions without showing them modern technologies. When educating students, students should be equipped with the necessary theoretical knowledge that will allow them to solve all problems, issues in their field, as well as show them the available tools, technologies on the labor market. It is necessary to update the classes in terms of what is happening in business, as well as to take into account generational changes.

Based on more than 10 years my experience as a teacher at the Poznań University of Technology, I would like to share my observations regarding the introduction of modern technologies in the field of Logistics. During these several years, there has been a significant development of simulation technologies and interest in their use in industry, including within business projects. Computer simulations have evolved from 2D simulations, through 3D simulations to digital twins, which have been popular for several years. In addition to the use of computer simulations to solve a specific problem, an interesting area is also virtual and augmented reality and how it can be used in the teaching process, which is what I intend to focus on in this article.

Virtual and augmented reality in didactic at Logistics course – in literature

A bibliographic analysis was conducted to identify and show how other scientists perceive the use of VR and AR in teaching. It was decided to check the number of articles on the described issues in the Web of Science database (accessed from the Clarivate Analytics server) available at the Poznan University of Technology and the publicly available Google Scholar database. The results obtained are presented in Table 1. The entire database was searched, without narrowing the search area – this behavior was intentional. The author wanted to show the popularity of the described issues. This quantitative review is to show the level of interest in the described issue by scientists.

At the literature can be found articles about virtual reality in different context. Some examples:

- The use of Virtual Reality in science has a wide application in medicine. Many publications on this topic can be found in the literature. Examples of them are: (Duan et al.), (Völter and Krämer), (Li Lanet al.).
- In the literature database, articles that describe the use of VR in teaching at universities can be found (Stecula), (Sun et al.), (Hirsch et al.), (Nanu et al.). (Balyk et al.).
- Examples of articles about VR in the context of education in the area of logistics: (Ogrizović et al.), (Wong and Lee).
- In the case of augmented reality, the number of articles is less than half that of VR. Examples of publications on the use of AR in higher education: (Sonkanok and Saenpich), (Blas wt al.).

Table 1: VR and AR in literature. Source: own study, based on Web of Science database (accessed from the Clarivate Analytics server) and Google Scholar.

No	Searching word	Number of articles at Web of Science database (accessed from the Clarivate Analytics server)	Number of articles at Google Scholar
1	"virtual reality"	86777	2080000
2	"virtual reality" + didactic*	470	43400
3	"virtual reality" + didactic* + logistic*	4	6130
4	"virtual reality" + education*	18537	1390000
5	"virtual reality" + education* + logistic*	154	40500
6	"virtual reality" + "education* + logistic*"	1	27
7	"augmented reality"	39316	837000
8	"augmented reality" + didactic*	351	23500
9	"augmented reality" + didactic* + logistic*	2	3290
10	"augmented reality" + "logistic* didactic*"	0	0
11	"augmented reality" + education*	9829	473000
12	"augmented reality"+ education* + logistic*	76	27100
13	"augmented reality"+ "education* + logistic*"	0	8

Using VR and AR in didactic at Logistics course – in reality

For over a dozen years, students of Logistics course at the Poznan University of Technology have been realizing a simulation project in cooperation with business in their third year of studies as part of the subject of logistics process design. The project area concerns logistics in the broad sense, from the warehouse zone to internal logistics, as well as supply chains. The topic and scope of the project are defined in cooperation with entrepreneurs, which meets their needs. This approach means that both the entrepreneur and the students are winners (win-win). The entrepreneur receives a different perspective on the topic along with the results, and students can work on real cases. More information can be found at <https://socilapp.put.poznan.pl/>. An extension of the use of modern computer simulations is the use of virtual reality (VR) or augmented reality (AR) as part of a project or diploma thesis.

Virtual reality in didactic at Logistics course

Students have the opportunity to use VR goggles and move into virtual reality. By putting on the goggles and moving to a virtual world in which a factory is mapped, or even a demonstration assembly station, the perspective of vision changes. By playing the role of an operator at an assembly station or an operator of a logistics train, a person automatically begins to pay attention to the arrangement of the location, to whether the containers with parts are not too far away or too low. In the context of a logistics train, to whether the arrangement of containers on a logistics trolley is well planned (e.g. the height of the shelves). Person instinctively try to reach a given thing and we find out experimentally whether it is within reach of our hands. By performing a specific movement many times, you can check whether it is comfortable for you and whether any part of your body does not get too tired, despite the fact that there is no load on the element you are moving. Designing a route for a logistic train can also be verified in virtual reality. When designing a route, students often focus on whether the train will pass or fit, but do not pay attention to the issue of arranging this route against the wall. Being in VR as an operator of a logistic train that travels for a longer time along the wall, they experience discomfort, they feel better in an open space, e.g. between stations. Based on this observation, we can assume that from a human perspective, it is better to design routes in an open space, and not one that is overwhelmed by a wall, if of course there is such a possibility. I believe that it is important to educate future logistics staff not only in the scope of how to design something optimally in terms of costs, but also in such a way as to take into account human needs, not only resulting directly from ergonomics, but also in the scope of mental comfort, which in the era of problems with employee availability will be an additional benefit for a given company. At figure 1 it is presented the use of virtual reality for checking the position when reaching items from a container on a shelf. At fig. 1a is shown analyzed shelves. At fig. 1 b,c it is picture of person in VR goggles who tested this solution. When you put on the goggles and move to a self-created model, you achieve the effect of identification with what has been built and verification of what has been designed. We instinctively compare what we see in the goggles with what we saw in reality. Often we also notice certain things that were not visible from the computer, e.g. the above-mentioned issue of the proximity of the wall.

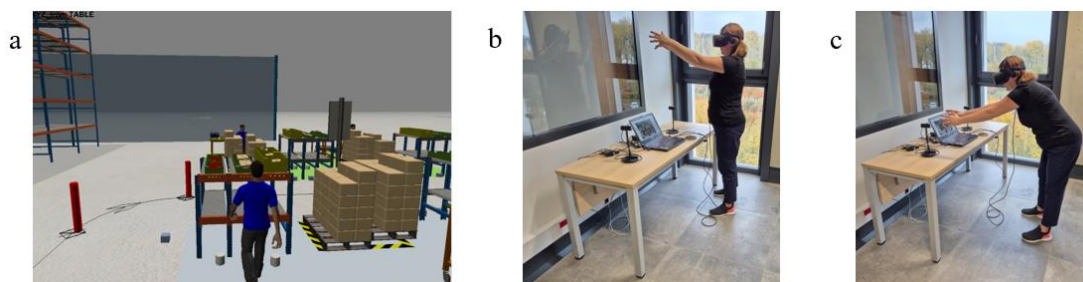


Figure 1. The virtual reality in use. Source: own.

Examples of benefits of using VR in combination with computer simulation in the logistics field:

- the ability to verify the model being created (feeling of being inside),
- the view from the operator's level, which allows, among other things, verification of reaching containers, verification of the arrangement of storage fields, and the place within the station,
- paying attention to issues affecting the psychological comfort of work (not building up the employee with high shelves at the workstation),
- the opportunity to personally test various solutions regarding the allocation of goods within the stand, logistics trolley and check how comfortable they are,
- sensitizing students to aspects of psychological comfort, which should translate into the student's later work and a broader perspective on problems.

Augmented reality in didactic at Logistics course

As part of the mentioned subject or diploma theses, students have the opportunity to use the ARFactory mobile application, which was created by the Poznan Supercomputing and Networking Center, as part of the Shop4CF project financed by the EU under the Horizon 2020 program. Using this application in combination with a

simulation model created in the LogABS simulation software used and taught at the Poznan University of Technology in the field of Logistics, students have the opportunity to move into augmented reality. The ARFactory application allows for inserting basic objects into the simulation model in real time (on a live preview), while maintaining their size and location (fig. X). On the other hand, it allows for applying the proposed solution (concerning adding a new object) to a live image of the analyzed area and checking how it will look like, whether a given element will fit in the expected place and whether access to it will be sufficient. This application allows for the use of augmented reality to arrange the factory space and export data to the LogABS simulation system. Fig. 2 shows the use of the mentioned application as part of the non-student Shop4CF project. Figure 2a shows the use of ARFactory to transfer the station layout to the simulation software. Figure 2b shows the plotting of the proposed object on the station image in real time.

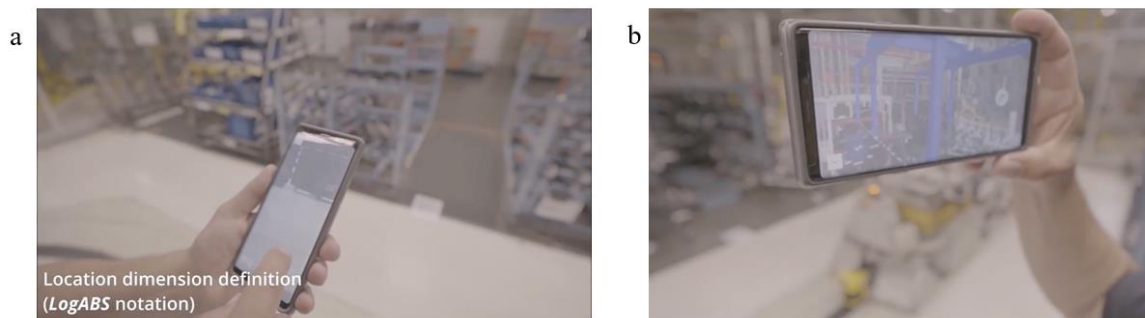


Figure 2. The use of ARFactory application. Source: screenshot from video Intralog_DT - Digital Twin For Intralogistics from <https://www.youtube.com/watch?v=jXmVVrpC3Lk>.

In 2023, one of the student groups carried out a project on ergonomics at the workplace in the automotive industry and used this application to check whether the proposed technological solution was possible to implement. The ARFactory application was also tested as part of diploma thesis in terms of its usability and functionality (Szczygieł).

Examples of benefits of using ARFactory in combination with computer simulation in the logistics field:

- the ability to enter objects into the simulation model in real time, taking into account and correcting realistic dimensions of objects on an ongoing basis,
- automatic loading of the station dimensions into the model, based on the markers placed on the floor,
- the ability to put the proposed objects on the image in real time in order to verify the proposed solution in a live system, taking into account the realistic movement of employees and other objects.

Conclusions

The availability and familiarity of simulation software by students, along with awareness of the availability of VR and AR tools, results using these technologies in diploma theses or students projects. As part of the diploma theses, students delve deeper into the proposed technologies and learn more about their application possibilities and limitations. Giving students the opportunity to use the above technologies broadens their technological knowledge, as well as their way of perceiving problems and methods of solving them. By taking on the role of a specific employee and looking at the problem from his perspective, the proposed solutions become more tailored, also taking into account psychological feelings. The designed systems are no longer just a concept "on paper" at this point, but can be moved inside them, which allows for a broader view of the analyzed and designed area. Students who know such solutions and have the opportunity to use them are able to offer their future employer a more in-depth analysis of the process, with a view from the perspective of various interested people, including manual workers. In the case of AR, they are able to propose and test the proposed solution without interfering with the real system, while giving a sense of being in this system, inside it.

In my opinion, an interesting solution from the teaching point of view would be to build VR games, e.g. in the area of internal transport, supply chain or inventory management. Another interesting aspect is the construction of choice scenarios in a simulation model for a real case and the consequences of this choice in the context of logistics processes, along with the possibility of seeing each option in VR.

This article aims to show how VR and AR are used at the Poznan University of Technology in the Logistics course by people belonging to the SOCILAPP center and what are the possibilities and benefits of such solutions. Only a few use cases are shown in this article, not all the work and possibilities. I believe that this is an introduction to the discussion among lecturers on how they use the mentioned technologies in didactic and what other technologies can be used in the case of education in the field of logistics, in order to improve the qualifications of future graduates.

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